

Proposal ID #: 124528

Review of Proposal Dual Readout Calorimetry- LAB 11-438

This proposal takes a three prong approach to trying to improve the energy resolution of calorimeters while keeping the cost reasonable.

- 1) It proposes to develop cost effective crystal scintillators with a target price of \$2/cc.
- 2) It proposes to develop photo-sensors sensitive in the short wavelength regime.
- 3) It proposes to study hadron shower development using GEANT and improve the GEANT simulation.

1. Scientific and/or technical merit or the educational benefits, as appropriate, of the project;

1a. Physics Motivation: Is there a clear collider detector based physics motivation? What measurement or class of measurements would benefit from this detector technology?

The proposal only lists a limited physics motivation for improving the calorimeter resolution, namely distinguishing W and Z vector bosons in their hadronic decay mode. This is very important, but improving the calorimeter energy resolution without introducing large tails in the resolution will improve almost all physics measurements using jets in the final state. Jet resolution can be a limiting factor in one's ability to calibrate and understand jets in a hadron collider. So this proposal will affect a large number of physics studies and improving jet resolution is a very high priority for future high energy experiments.

Improving GEANT will allow better calibrations and better understanding of backgrounds and will therefore benefit almost all physics measurements.

1b. Generic Research: Is this generic research that can benefit a significant fraction of detectors for high-energy physics as opposed to engineering to make a technology work for a particular experiment?

Since all high energy detectors have a calorimeter, this research will benefit future high energy experiments. Due to the cost of calorimeters, it is doubtful that the crystal scintillator research would affect present detectors or any current upgrades to detectors. The cost and time to develop such calorimetry will most likely only benefit future detectors. Improvements to photodetection could benefit future experiments as well as upgrades since it may be possible to replace existing photo-detectors with improved ones in an upgrade and thus improve the performance of a detector.

Any GEANT improvements would be beneficial for current experiments as well as any future experiments and upgrades.

1c. Impact vs Risk: How does the risk of failure compare to the magnitude of the potential impact?

I find the risk to be fairly high in this proposal. All of the researchers are experts in their fields and very highly qualified to do this research. However, two of the primary goals of this proposal sound difficult. One goal is to reduce the price of crystal scintillators to \$2/cc. The current cost of crystal scintillators is not given in the proposal so it is hard to judge how much cheaper they must become. It may be in the references, but I searched on the web and looked at some of the references and could not find the current cost of crystal scintillators. Does the cost need to be reduced by a factor of 2?, 10? or more?

The statement is made that data obtained from the studies will be fed back to the crystal growers. This will lead to improved processing and will reduce the price and make better crystals. This may be true, but it still makes it very difficult to judge if the goal of \$2/cc can be achieved.

Another goal is to improve Geant since according to the proposal in regards to different versions of GEANT4, "the differences between these simulations are disturbing". In citation 3 from 2009 it states that "Big differences when using different physics list. Started dialog with the GEANT 4 team and will continue to work with them". So the issue of improving GEANT has been going on for some time and yet this issue still remains. This is not an easy problem to solve and I know of a few failures in this area.

However, improved resolution and having a simulation that describes the data well are both very important for future high energy physics experiments so the rewards of success are very high.

2. Appropriateness of proposed method or approach,

I believe the researchers have a well thought out approach to the problem. They clearly have the expertise in studying scintillators, have the connections to crystal growers, have expertise in photo-sensors and understand what must be done to have them function in future high energy experiments. An expert in computing will be working on the GEANT studies.

The only part that seems lacking is even with all of these studies on scintillators can the price be reduced to the stated level? This part of the proposal is vague on how exactly the price reduction will take place.

3. Competency of the applicant's personnel and adequacy of proposed resources, and

All personnel in this proposal are highly competent experts in their areas and have a proven record of success in their respective areas. The proposal clearly shows nice results from previous work and shows an understanding of what must be done. A computer expert will be working on GEANT, and experts in scintillators and photo-detectors will also be working on this project.

The resources to perform the research is available.

4. Reasonableness and appropriateness of the proposed budget.

The budget is primarily for personnel, travel and material costs. Money is requested for a postdoc to help in the research. The travel budget is high, but many of the appropriate travel is to foreign conferences. One must purchase photo-sensors and procure crystals so the budget seems reasonable and appropriate.